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GEOGRAPHIC AREA, ORR, CONTRIBUTION TO NIE 11-1-64:

THE SOVIET SPACE PROGRAM

POSSIBILITIES OF SOVIET PARTICIPATION IN AN INTERNATIONAL GEODETIC SATELLITE PROGRAM

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I. Introduction

The need to refine accuracies in the geodetic positioning of hardened missile launch sites has been intensified by improvements in hardening and in guidance systems. The geodetic satellite offers a time-saving and economical means of increasing knowledge of the size and shape of the earth, reducing uncertainties in intercontinental ties, and obtaining control points for mapping. The most effective utilization of the geodetic satellite would be achieved through an international scientific cooperative program involving not only the United States and the USSR but also other advanced nations. The prospect for significant Soviet participation in an international geodetic satellite program is most unlikely, however, because disclosures of Soviet geodesy would unavoidably result from an exchange of data. Soviet policy prohibiting the release of geodetic and topographic data is rigidly maintained. Although unlikely it is possible that the USSR might release highly generalized results of such a program, but there is no possibility that it would release any geodetic data on the USSR that would have the remotest application to US mapping of USSR territory.

II. Soviet Security Policy on Geodesy

Restrictions on the release of Soviet topographic maps and geodetic catalogs to map collections outside the USSR have been in force for a very long time and are notably successful. Not until the Germans overran the Soviet regional map centers in World War II did they obtain modern maps and geodetic data on the USSR, and these maps and data now constitute the basic holdings of the United States. To date, not a single postwar sheet of the Soviet series at 1:100,000 is available anywhere outside the USSR, despite the fact that over 20,000 quadrangles have been completed. Soviet postwar geodetic and gravity data catalogs also are unobtainable, despite constant pressure on Soviet scientists at international scientific meetings. Elaborate Soviet security procedures and similar restrictions adopted by the Bloc countries are designed to prevent the loss of topographic maps and geodetic and gravimetric data to the West.

Soviet participation in the activities of the International Association of Geodesy (IGA), of the International Union of Geodesy and Geophysics (IUGG), and in the International Geographical Union (IGU), is carefully limited to avoid any risk of releasing maps or disclosing data pertaining to them. Soviet geodesists have abstained from programs and symposia that require release of geodetic and gravimetric data and from commitments that would allow outsiders to make geodetic or gravimetric observations in the USSR. Only recently, has a US gravimetrist been allowed by East Germany to make a tie with the world gravity base station at Potsdam, and no such ties to points in the USSR have been permitted.

The Soviet policy of restrictive security appears to have been exercised in August 1963 against Soviet scientific participation in the activities of the IUGG's Special Study Group (SSG) No. 26, Geodetic Connections by Means of Artificial Satellites. More recently, at the Committee on Space Research at Florence in May 1964, the Soviet delegate who chaired a group session on geodetic satellites restricted the presentation of a US paper on the US global triangulation program (using the ECHO passive satellite) to 10 minutes. The chairman allowed no discussion, although the program ended 25 minutes ahead of schedule, and later opposed the introduction of a resolution recommending international participation. Whether Soviet security policy will continue to prevent European Bloc participation (East Germany, Czechoslovakia, Poland, and Rumania) remains to be seen. A Czech geodesist has expressed in print the need for international participation if maximum benefits are to be achieved, and reportedly, East European geodesists have approached UK scientists on the possibility of organizing an international program. But to date, no concrete proposals have been made.

III. Cooperation in Satellite Mapping

There is virtually no possibility within the present international political environment that the Soviets would accept a proposal to exchange mapping data obtained by satellite. The Soviets are fully aware of their basic advantage over the United States in geodetic target positioning, and they have been able to develop and maintain this advantage through denial of Soviet topographic maps and geodetic and gravimetric data to the United States. At present, the most extreme Soviet uncertainties in the map location of targets anywhere in the United States would not exceed 1,500 feet, whereas US uncertainties in vast areas of Siberia exceed 1 nautical mile. Hence, through continued denial, the USSR would retain a net advantage over the United States, which through lack of data would be forced into significantly greater relative inaccuracies. The Soviets are likely to be further persuaded to abstain from any exchange of satellite data by the fact that

their present plan to develop a geodetic system and 1:25,000 map coverage of the entire USSR will give them an advantage in antimissile tracking throughout the vast regions of the USSR, an advantage that would be lost if it released data to the United States.

IV. Cooperation in Satellite Geodesy

Satellite geodesy, as distinct from satellite mapping, offers a major research tool to provide unique data that can be used in delineating the size and shape of the earth and in effecting geodetic ties between continents and islands. Two types of geodetic satellites are being developed. One, an active satellite with a flashing light and electronic system, can yield data to connect various geodetic datums to establish a single world datum and to make possible the determination of a point on or near the earth's surface in a world coordinate system. Tracking observations from such a satellite also can yield data to establish a more precise model of the earth's gravitational field and to determine the locations, magnitude, and intensities of large gravity anomalies. Such tracking data will be used for ancillary scientific studies of air-density, atmospheric light attenuation, instrument calibration, and various studies of dynamics of satellite motion. The first such geodetic satellite, ANNA, was launched by the United States in 1962 and is still functioning.

The second type of satellite is passive in mode and is being developed for geometric geodesy. A 100-foot sphere is to be launched to an altitude of 2,000 nautical miles in a polar orbit and observed for spherical triangulation data. To establish a worldwide network of 36 points in a three dimensional cartesian coordinate system the satellite will be photographed against a background of stars. The goal of optical and electronic tracking and data reduction in connection with this satellite is to reduce the error in the connections between intercontinental geodetic systems from an order of 600 feet to less than 100 feet.

Although Soviet sources refer to geodetic satellites, there are no known Soviet plans for launching one. On the other hand, the Soviets have established an elaborate tracking network with 90 stations in the USSR as well as stations in Poland, Czechoslovakia, East Germany, Rumania, Hungary, and Bulgaria and have conducted both gravimetric and geometric geodetic research utilizing satellite observations. They used observations made from their own Sputnik III to determine the flattening of the earth and used synchronized observations from the US ECHO I to determine coordinates of Soviet stations to $\pm$50 meters. At various Soviet and Bloc meetings the Soviets have shown a keen interest in US geodetic satellite programs. It

is obvious that any satellite program which adds to knowledge of the size and shape of the earth and which reduces the uncertainties of intercontinental ties will benefit the USSR as much as the United States.

Despite Soviet interest in the improvement of geodetic knowledge, Soviet cooperation with the United States or participation in any international geodetic satellite program would be severely limited by rigid Soviet security regulations dictated by military considerations. The Soviets are fully aware that the major interest in and support of US programs of satellite mapping and geodesy is provided by the military services. Thus, there is no possibility that Soviet geodesists will be allowed by their security officials to participate in any international scientific activity that would require the release or exchange of Soviet photographic plates, electronic tracking data, or related primary information that would disclose the geodetic location of even a single station or point on USSR territory. While this policy may handicap the Soviets in improving their own intercontinental ties, they are likely to assume that they can obtain interconnections between the United States and Eurasia through either international scientific exchanges of data or covert collection from European sources.

On the other hand, it is likely that Soviet scientists will participate in international scientific symposia and conferences on satellite geodesy in those ancillary or secondary fields where significant data disclosures are not required. They probably will give reports in generalized or summary form on some phases of gravimetric geodesy, on minutiae of orbital analysis, on tracking and timing instrumentation, and on geodetic constants. Also, Soviet restrictions that prevent Soviet scientists from participating in the main stream of international geodetic activities may be tempered to some extent to allow Soviet participation in the US passive geodetic satellite program. The United States plans to locate three points of the 36-point network in Antarctica -- one of them at Molodezhnaya, the newest Soviet station. Soviet participation in a geodetic program in Antarctica would offer a safe back-door entry to wider activity at international scientific meetings. Since such an approach would fit into the geodetic research program the Soviets have undertaken in Antarctica, would also be consistent with established Soviet policy on Antarctica, and would give the Soviets added scientific prestige, the USSR is more likely to cooperate in the Antarctic phase of the passive geodetic satellite program than in any other part. It is highly unlikely, however, that the USSR will participate in any other activities of an international geodetic satellite program.

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